

Impact of a Televideo Application on Health Care in a Nursing Facility

A component of
Indianapolis Network for
NGI Applications to Telemedicine
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Potential Benefits of Telemedicine

- Bring health services to patients
- Improve quality of care
 - Decrease time for diagnosis and decision-making
 - Improve continuity of care
 - May improve adherence to treatment
- Continuing medical education
- Reduce costs of some care

Outline for Today

- Clinical setting
- Goals of project
- Assembling equipment in the laboratory
- Deployment in the clinical setting
- Clinical trial
- Conclusions

Clinical Setting

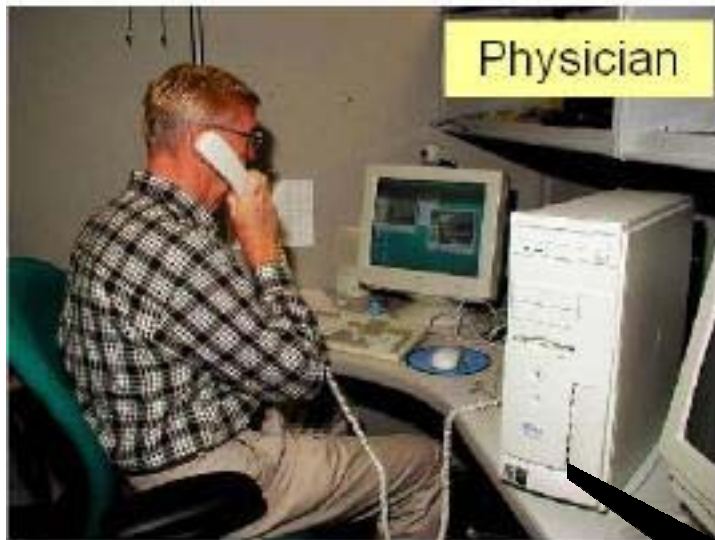
Clinical Setting

- Nursing homes: 2 million high-risk disabled patients with a high prevalence of multiple, chronic illnesses.
- Lockefield Village Health and Rehabilitation Center
 - 240-beds
 - Multiple levels of care
 - Nurse practitioners and 7-10 physicians share call schedule



Goals of Project

Goals of Project

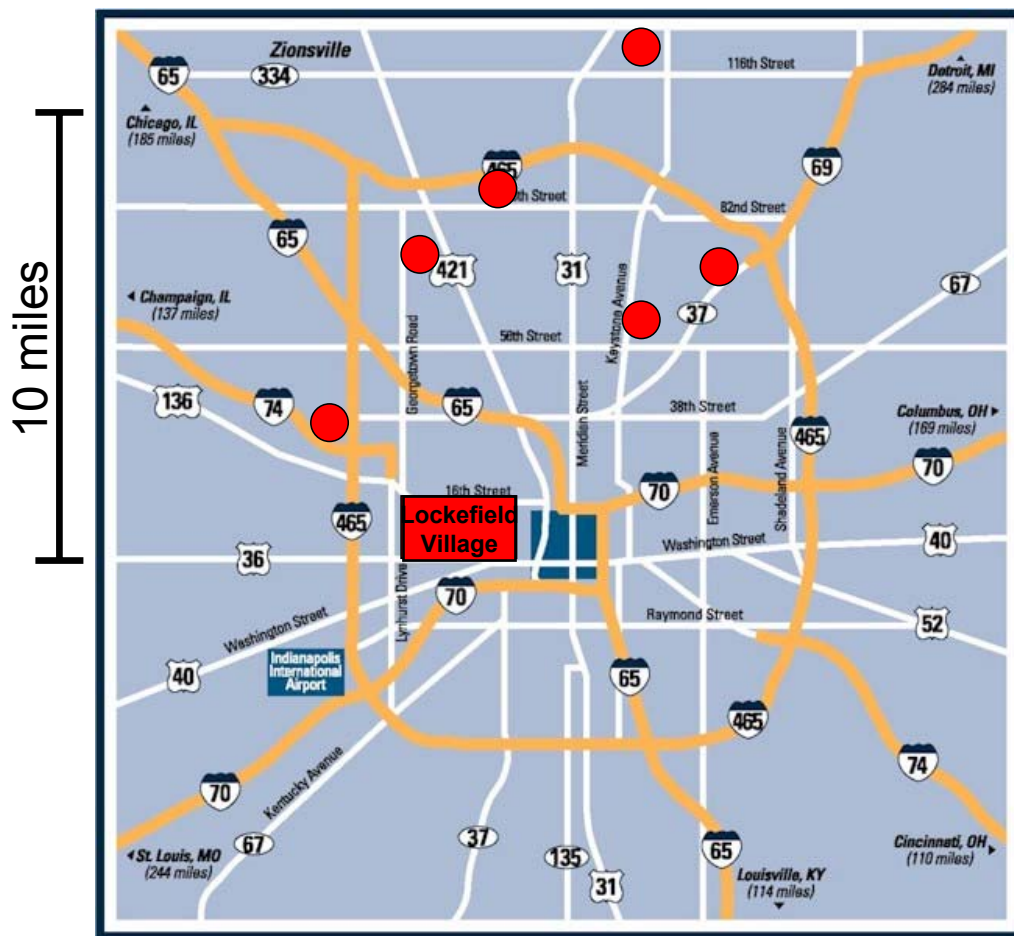


- Implement video-based teleconferencing between health providers at home and patients in a nursing facility
- Measure impact on health outcomes

Secure transmission



Peripheral Physicians and Central Patients



Red dots indicate physicians' homes

Assembling Equipment in the Laboratory

Needs

- Tolerance to standard Internet conditions (varying bandwidth; T1 too expensive)
- Available in all rooms in nursing home
- Secure (encrypted) transmissions
- “Simultaneous” live videoconferencing and recording of videos (i.e., file storage)

Tolerance to Standard Internet Conditions

- MPEG
 - Very high quality, especially motion
 - Requires constant high (1.5 Mbps) bandwidth
 - Expensive and less available
 - Chosen for recording (file storage)
- H.323 / H.261
 - Smaller frame size and lower frame rate
 - Requires less constant bandwidth (64 Kbps and up)
 - Less expensive and greater industry support
 - Chosen for live videoconferencing

Available in All 200+ Rooms in Nursing Home

Compaq DeskPro P3 500 128 Mbyte RAM	1,000
NEC 1525X LCD TFT monitor	670
Cisco Wireless PCI card	200
Polycom Soundpoint speakerphone	100
Cannon VC-C3 camera	1,244
Tilt/pan camera base	52
VCON Escort 25	600
Array MPEG recorder	1,000
Lowel Pro light	234
Pole for light	65
Retractable power cord	80
APC 650 UPS	260
CompuCaddy table	508
Metal shelf	12
Security alarm	60
TOTAL	\$6,085



*Alternative: hard-wire all
rooms*

Power Options



Wide Area Network Context

- Cable links from home physician to Internet to nursing home (many hops)

Major Problem #1

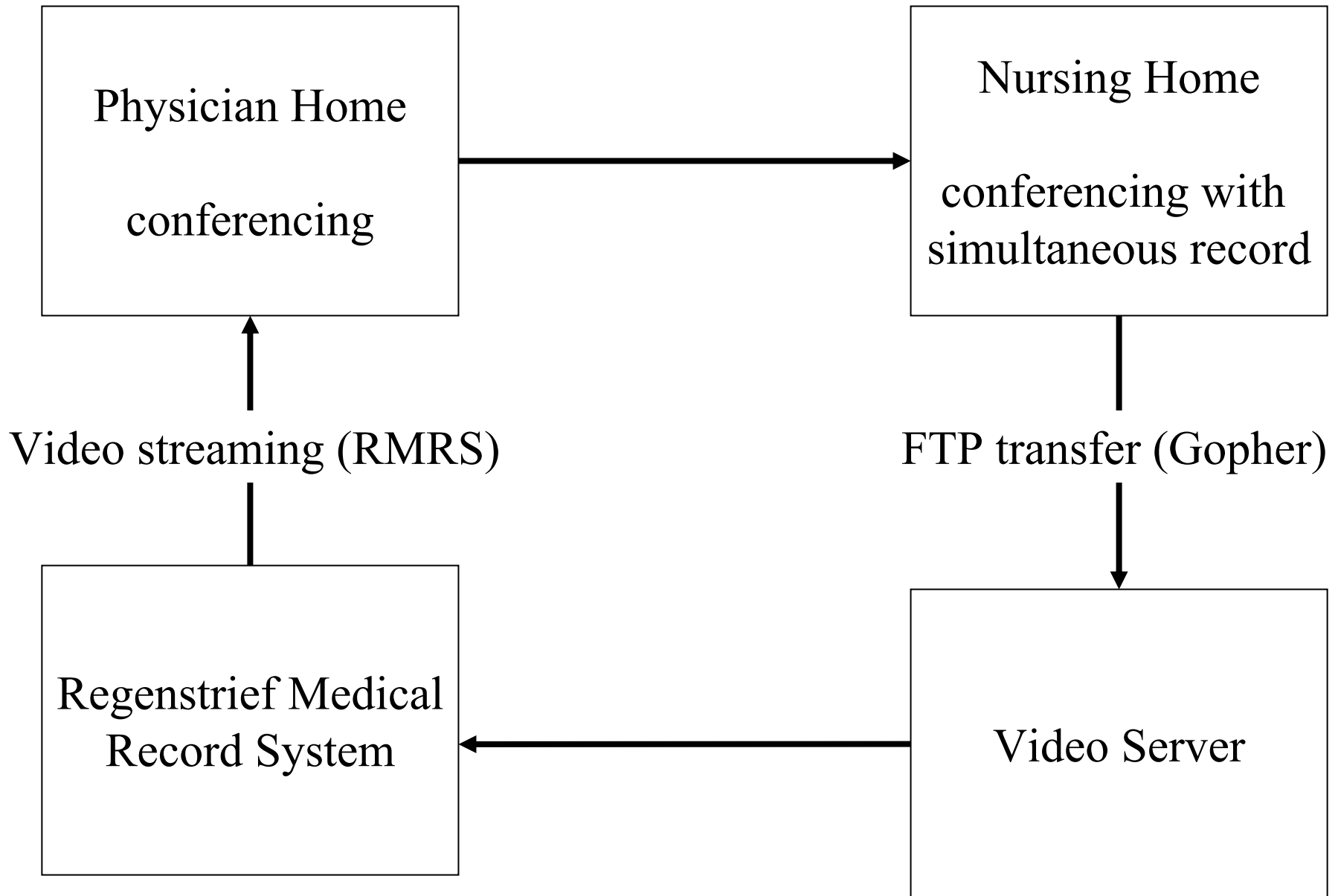
- Had to encrypt live video for privacy
- Internet Service Provider's standard contract prohibits router-based encryption on physician's side
- We had to produce our own solutions

\$230 Unix Router for Encryption

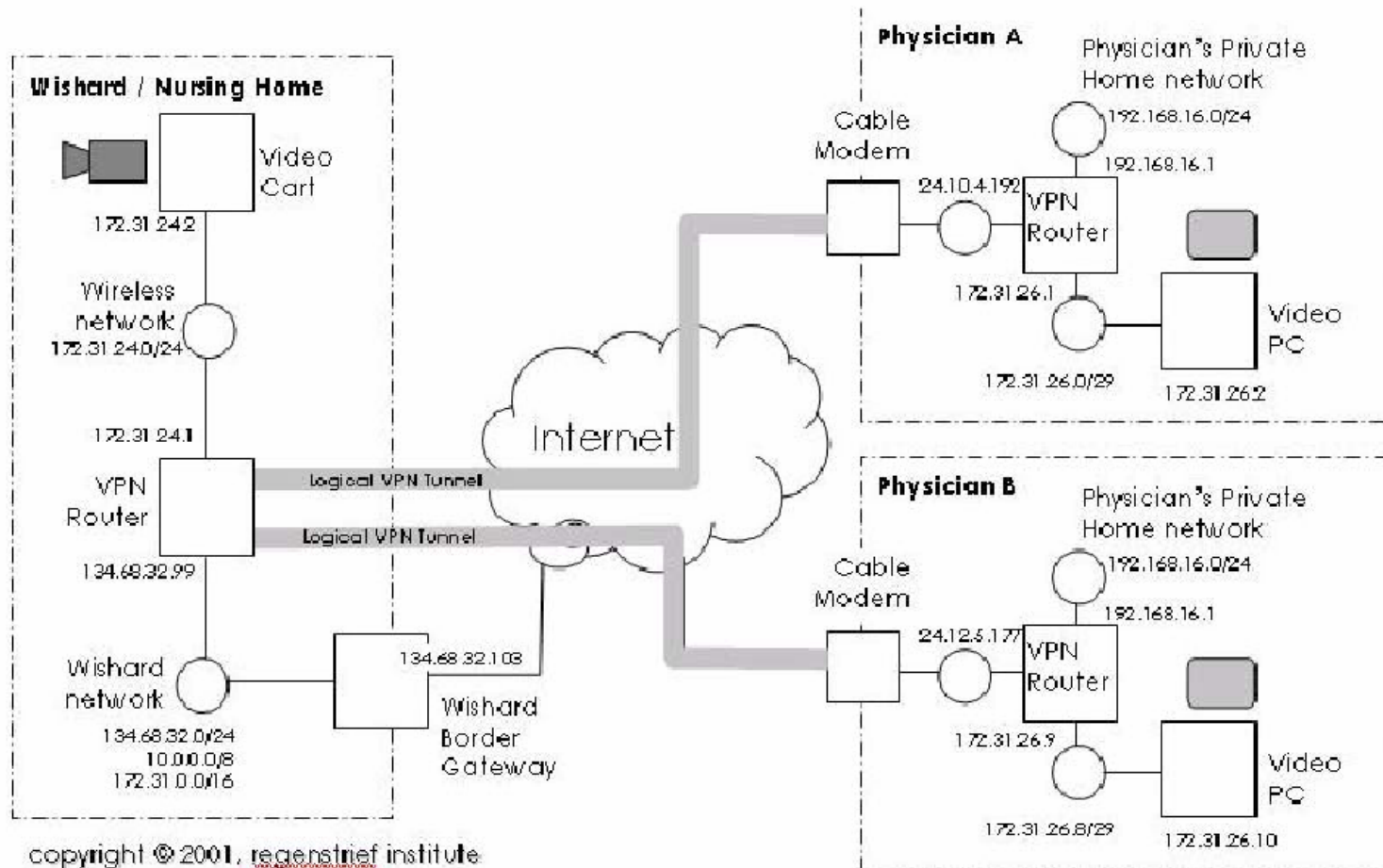


- Soekris net4501 router
- Open-source FreeBSD UNIX router
- IPsec with strong 256-bit encryption
- Wireless Encryption protocol
- 133 MHz AMD elan sc 520
- 64 Mb RAM
- 4.85" x 5.7"
- \$230
- 3 ports
 - Internet
 - Video PC: secure
 - Personal PC: pass-through

Simultaneous Live Videoconferencing and Recording



End to End Picture



Videoconferencing Example

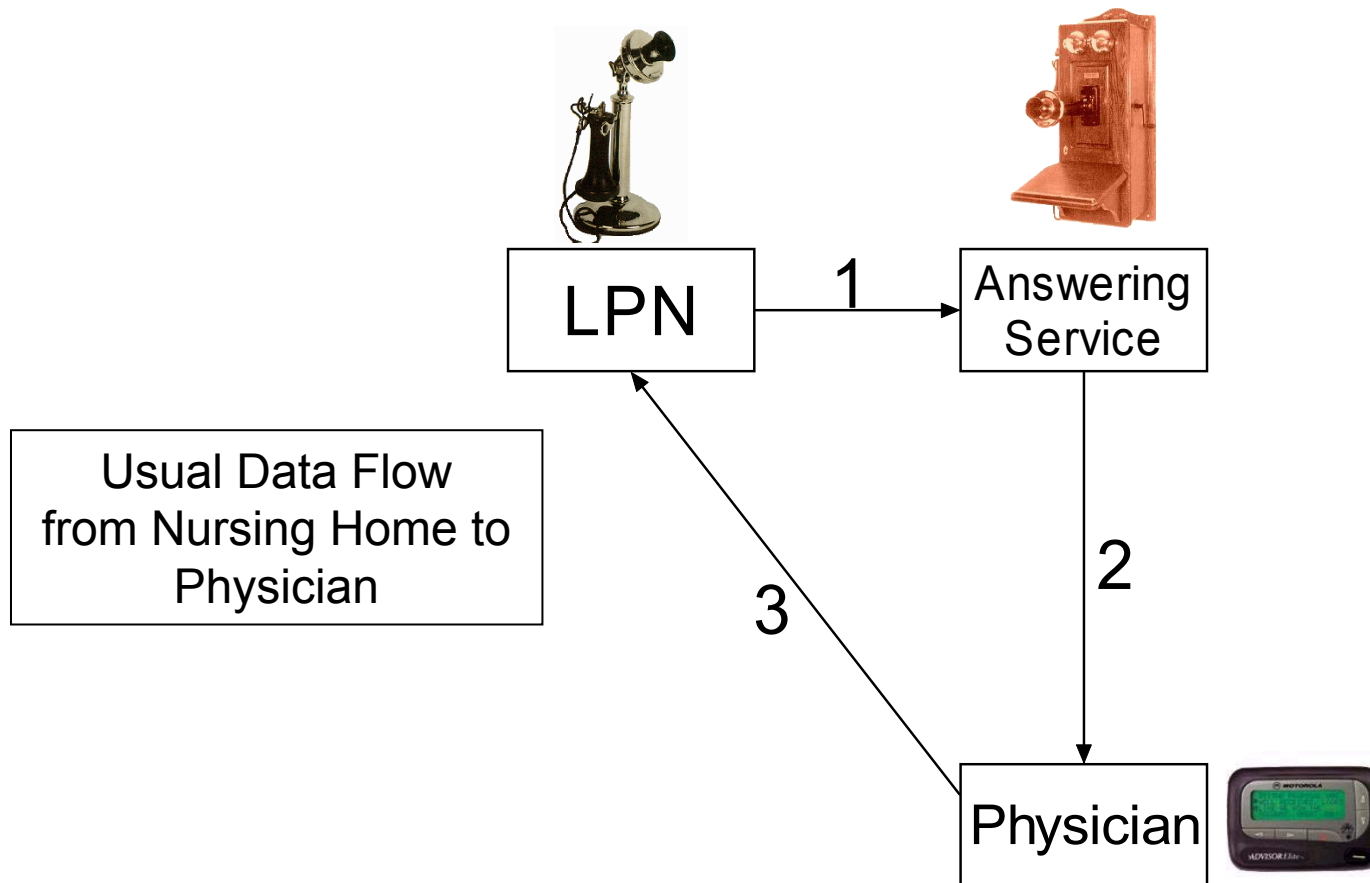
Deployment in the Clinical Setting

System Requires Training

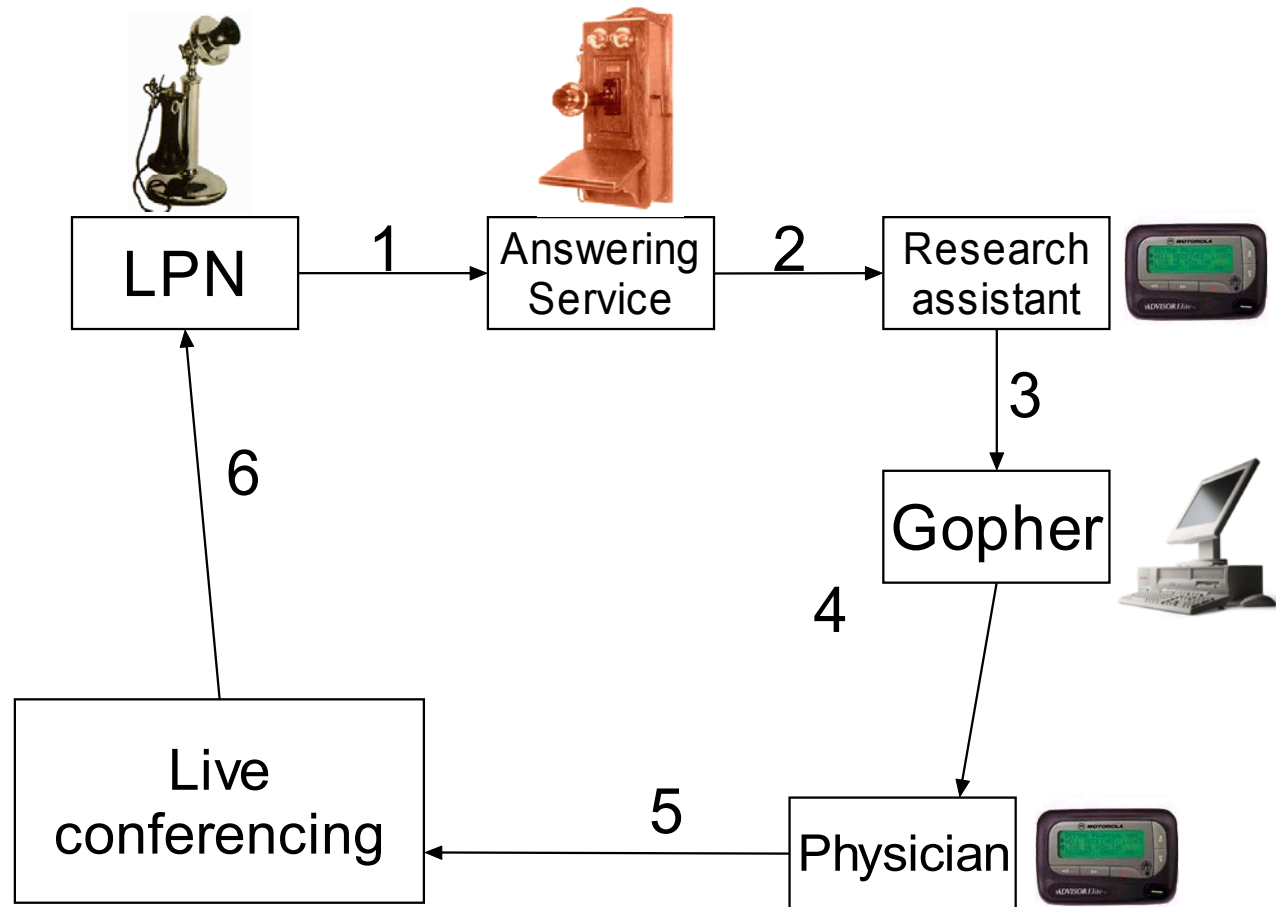
- Problem
 - High turnover of nurses
 - 3-person scheduling problem of telemedicine
 - Patient
 - Facilitator
 - Provider
- Solution
 - Dedicated research assistants

Spontaneous Videoconferencing

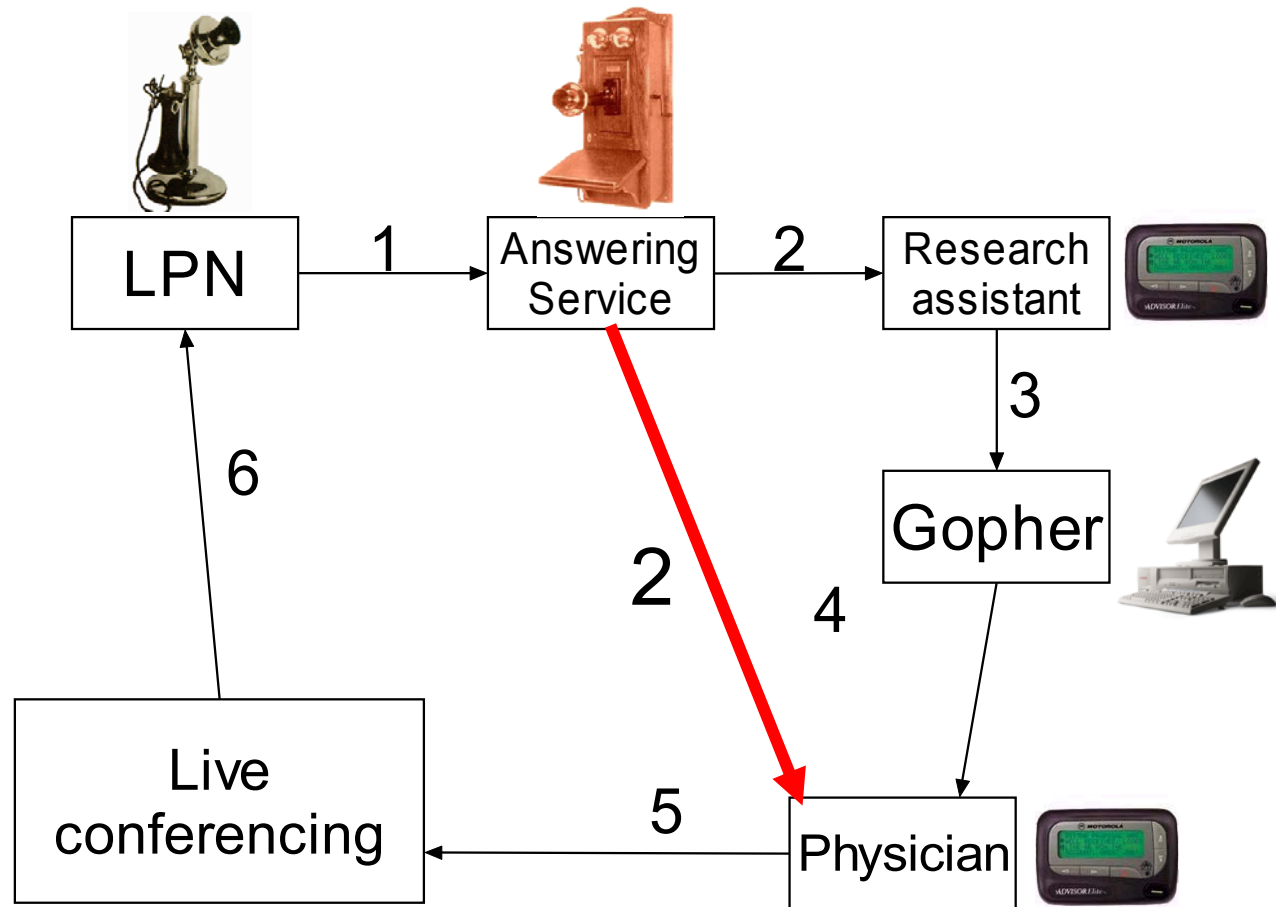
Who initiates? Who confirms



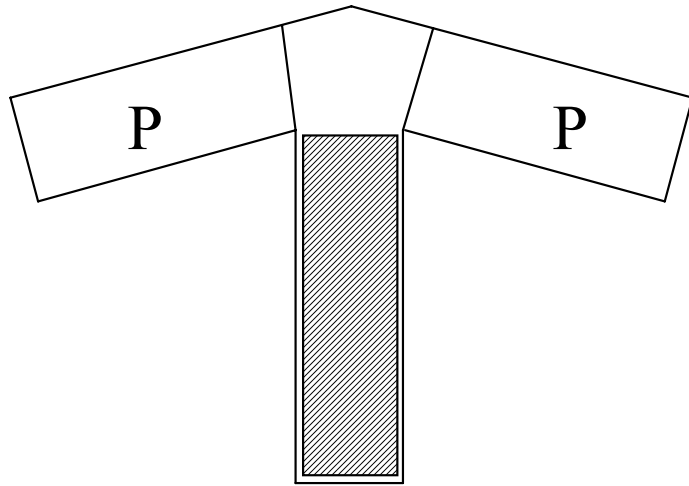
Augmented Data Flow to Intercept Calls to Physicians



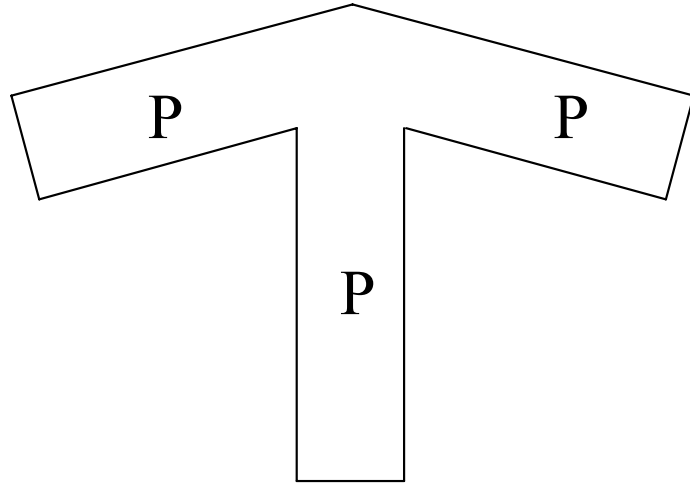
Revised Data Flow to Intercept Calls to Physicians



Wireless System Caused Low Apparent Bandwidth



Floor 1



Floors 2-4

Problem

Directional performance

AP350 base station cannot filter traffic

Solution

Better antenna

Router-based traffic filter to create private network

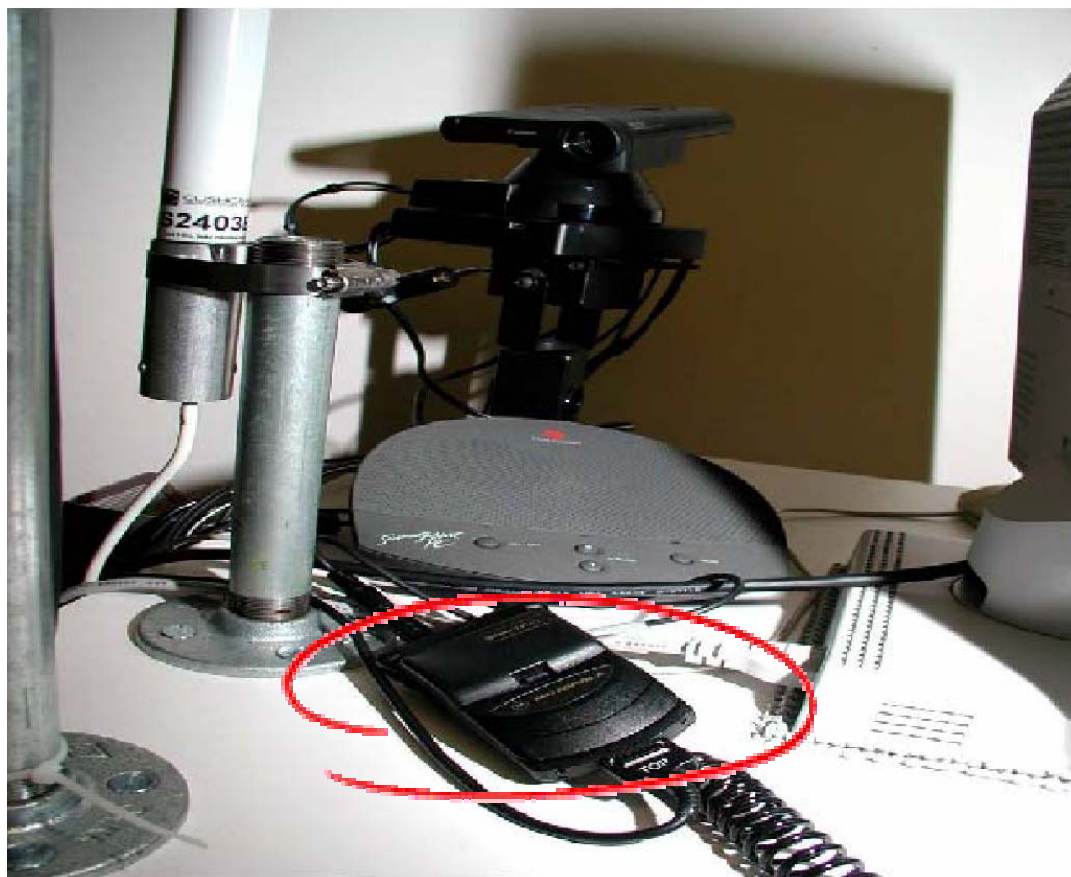
Audio dropout required alternative means for audio communications

- Numerous Internet hops
- Internet service provider limits bandwidth



Audio dropout required alternative means for audio communications

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Clinical Trial

Objectives

- Assess feasibility of using the laboratory-derived equipment in a real clinical setting
- Assess outcomes attributable to spontaneous, night-time videoconferencing for acute medical problems
- Assess whether videoconferencing could substitute for some bedside evaluations

Hypotheses

- Secure videoconferencing through Internet is feasible
- Satisfaction will be greater
 - Physicians/NP
 - Patients
- Fewer radiology/laboratory test
- Less referral to emergency department
- No difference in mortality
- Physicians will feel confident assessing medical conditions remotely

Components

Accessible to Providers

- All participants
 - Lab and radiology data
 - Previous orders, visit notes and discharge summaries
- Intervention participants
 - Live videoconferencing
 - Previously recorded videos
 - Baseline videos
 - Live videos

Electronic Medical Record's Integration of Link to Video

TEST,PATIENT9993 #0000999-3 (M) Age: 28 years [WISHARD]

Select a patient Browse Patient Record Other

Hide Menu Graph Setup Next Prev Praxis

Active Labs
Flowsheet
Clinical Synopsis
REPORTS
ALL REPORTS
Admission/Discharge
Cardiology
Operative
Pathology
Radiology
Visit/Procedure Notes
Face Sheet
Appointment History
Orders
ENCOUNTERS
Brief
Detailed
PRESCRIPTIONS
Inpatient
Outpatient
Surgery Log

TEST,PATIENT9993 #0000999-3 @WISHARD M 28yr

BLOOD CELL PROFILE	14-Mar-94 16:20	17-Oct-90	09-Oct-90	22-Aug-90	04-Jun-90	21-Aug-89 08:20	Units
<input type="checkbox"/> WBC	6.6 {a} ¶			8.0 {a} ¶	8.0 {a} ¶	6.6 {a} ¶	k/cumm
<input type="checkbox"/> CORRECTED WBC				3000.0 {a} ¶	3000.0 {a} ¶		k/cumm
<input type="checkbox"/> RBC	3.2*L {a} ¶			5.0 {a} ¶	5.0 {a} ¶	3.1*L {a} ¶	million/mm3
<input type="checkbox"/> HGB	9.5*L {a} ¶		9.0*L {a} ¶	10.0*L {a} ¶	10.0*L {a} ¶	9.5*L {a} ¶	g/dL
<input type="checkbox"/> HCT	30*L {a} ¶			39 {a} ¶	39 {a} ¶	30*L {a} ¶	%
<input type="checkbox"/> MCV	98*H {a} ¶			83 {a} ¶	83 {a} ¶	98*H {a} ¶	fL
<input type="checkbox"/> MCH	31 {a} ¶			28 {a} ¶	28 {a} ¶	31 {a} ¶	pg
<input type="checkbox"/> MCHC	32 {a} ¶			34 {a} ¶	34 {a} ¶	32 {a} ¶	g/dL
<input type="checkbox"/> RETIC CT		1.0 {a} ¶					%

{a} - From WISHARD, 0000999-3 TEST,PATIENT9993

IRON STUDIES	17-Oct-90	Units
<input type="checkbox"/> FERRITIN EIA	115 {b} ¶	ng/mL

{b} - From WISHARD, 0000999-3 TEST,PATIENT9993

Ad hoc flowsheet	15-Jul-02 23:30	09-Aug-01 21:44	09-Aug-01 21:17	07-Aug-01 11:44	11-Jun-01 21:50	30-Jan-01 0
<input type="checkbox"/> Video Baseline NGI						{a} ¶ ⊕
<input type="checkbox"/> Video Batch NGI	{a} ¶ ⊕					
<input type="checkbox"/> Video Interactive NGI		{a} ¶ ⊕	{a} ¶ ⊕	{a} ¶ ⊕	{a} ¶ ⊕	

Enrollment and Admissions

- Consent
- Proxy information
- Assessment of cognitive status
- Level and acuity of care

Nighttime Conferencing

- Acute nighttime problems
- Randomized study changed to observational
- Research assistant facilitate examination

Daytime Conferencing to Compare Remote to Bedside Evaluations

- Situations
 - Acute daytime problems
 - Wound care
 - Routine daily visits
- Video exam followed by in-person exam
- Assessment of new or changed orders

Sources of Data

- Enrollment and admissions
- Patient, nurse, and physician satisfaction
- Reports of technical difficulties
- Information about calls (pager messages)
- Video files
- Cost and other measures of utilization

Participants

Characteristic	All participants	Participants with videos
Age, years (mean)	61	76
Race, African-American	58	79
Gender, female	55	70
Number of calls, per resident who generated >0 calls		
1-10 calls	97	
>10 calls	3	
Number of videos, per resident with >0 videos		
1-2 videos		96
>2 videos		4

Cells contain percentages

**Results Will Be Made Available
Through Publications**

Conclusions about Spontaneous Videoconferencing through Internet

- **Feasibility:** spontaneous, Internet videoconferencing is feasible
 - Special planning needed in current setting
 - Need ease of use, minimal training
 - Videoconferencing via cable modem works
- **Usefulness:** limited in urban academic setting
 - Not useful for many medical conditions
 - Need permanent, low-cost, ubiquitous videoconferencing equipment
 - Reverse configuration (peripheral patients) might not work, due to slow uplink
- **Quality:** QoS needed for voice but not visual data
- **Routing:** needed for security and traffic filtering
 - Expansion of integrated security mechanisms will facilitate applications

NLM

NGI Telemedicine Study

- Greg Abernathy
- Heydon Buchanan
- Paul Dexter
- Joanne Fyffe
- Terry Ising
- Don Lindbergh
- Clem McDonald (P.I.)
- Theda Miller
- Marc Overhage
- Susan Perkins
- Gunther Schadow
- Sean Thomas
- Jill Warvel
- Michael Weiner